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Japanese Published Unexamined (Kokai) Patent Publication No. H3-17236; Publication Date: January 25, 1991; Application No. H1-149418; Application Date: June 14, 1989; Int. Cl.[5]: C22C 1/08; Inventor(s): Hidetoshi Matsuno et al.; Applicant: Nippon Kokan K.K.; Japanese Title: Happou Kinzoku no Seizou Houhou (Method for Production of Metal Foam)

Specification

1. Title of Invention

Method for Production of Metal Foam

2. Claim(s)

1. A method for production of metal foam, characterized in that a gas soluble to molten metal is dissolved therein; by rapidly reducing the pressure, gas bubbles are generated in the molten metal; while keeping the foaming state, the molten metal is solidified.

2. A method for production of metal foam, such that a gas soluble to molten metal is dissolved therein, by rapidly reducing the pressure, gas bubbles are generated in the molten metal, and that while keeping the foaming state, the molten metal is solidified, characterized in that when the foaming ratio of the obtained metal is defined at 0.8 or greater, an atmospheric pressure Pa inside an oven, treated at a reduced pressure, is controlled at the condition as shown in the following formula in relation to a balanced gas partial pressure Px of a soluble gas component X dissolved in the molten metal:

$Px - Pa \ni 0.1$ (atm)

3. Detailed Description of the Invention

[Field of Industrial Application]

This invention pertains to a method for production of metal foam having a gap inside.

[Prior Art]

Metal foam with fine gaseous foam is uniformly dispersed in the entire metal of aluminum foam and the like is used for building materials endowed with hardness at a lighter weight, fire resistance and sound absorption, container materials that are used for automobile impact absorbing materials endowed with impact absorption and a lighter weight, and sandwich panel core materials, endowed with hardness at a lighter weight.

[Problem to Be Solved by the Invention]

Such metal foam is usually foamed while a foaming agent is mixed in molten metal in the production. However, it is difficult to uniformly disperse the foaming agent, thereby resulting in a problem on the productivity.

The present invention is produced in consideration of the above disadvantage and to offer a new method for easily obtaining a uniform foaming state without applying the mixing operation as mentioned above, making it difficult to achieve a uniform dispersion.

[Measures for Solving the Problem]

In order to eliminate the disadvantage, the invention is basically characterized in that a gas soluble to molten metal is dissolved therein; by rapidly reducing the pressure,

gas bubbles are generated in the molten metal; while keeping the foaming state, the molten metal is solidified.

The constitution of the invention is described hereinbelow along with an example as illustrated in Fig.1 (a), Fig.1 (b) and Fig.1 (c). As shown in Fig.1 (a), a gas (such as a H_2 gas or N_2 gas if molten steel is used) soluble to a molten metal 1 is first dissolved in the molten metal 1 by a bubbling means. At the time, if the bubbling is performed in a pressure added atmosphere, the gas is dissolved at a large amount. Next, when the pressure of the atmosphere is rapidly reduced to create a vacuum state, as shown in Fig.1 (b), the gas component previously dissolved appears on the entire area of the molten metal 1 in the form of gas bubbles. While keeping the state, as shown in Fig.1 (c), copper plates 2 with higher conductivity are cooled and inserted in the molten metal 1. By these means, the molten metal 1 presented between the copper plates is quickly cooled to be solidified. The solidified portion X is then extracted as metal foam.

An experiment for the working example as described below is conducted by the inventors. At a practice of the aforementioned method, the conditions for a reduced pressure treatment so that foaming ratio H generally required for metal foam becomes 0.8 or greater is clarified, which is proposed as a second invention. More specifically, the invention is characterized in that the atmospheric pressure Pa inside an oven, treated at a reduced pressure, is controlled at the condition as shown in the following formula in relation to the balanced gas partial pressure Px of a soluble gas component X dissolved in the molten metal:

$Px - Pa \ni 0.1$ (atm)

[Working Example]

The working example of the invention is described hereinbelow in detail.

A Fe based molten metal at 1 kg is melted in a N_2 gas atmosphere, and the pressure is quickly reduced in a vacuum-melting oven. At the reducing of the pressure, the atmospheric pressure Pa inside the oven is reduced more than the balanced gas partial pressure Px of the component of the N_2 gas component in the molten metal, defining the mean of (Px – Pa) at 0.2 atm. At the time, a large amount of fine N2 gas bubbles is generated in the entire area of the molten metal to create a foaming state. After the foaming state has been identified, two copper plates having been cooled are inserted in the molten metal to solidify the molten metal presented between the copper plates. The solidified metal is obtained as metal foam. When foaming ratio H of a part of the metal collected is measured, it is 0.82.

During the experiment, the inventors find the following critical fact. A state at which the generated bubbles keep on lifting the metal from the beginning of the cooling operation from the foaming state to the solidification of the molten metal needs to be maintained, which requires a certain or more amount of the gas to be generated.

Accordingly, the inventors further conduct an experiment for studying a relationship between the in-oven atmospheric pressure Pa related to the amount of the gas bubbles generated and foaming ratio H of the metal foam, thereby obtaining the result as indicated in Fig.2. The drawing is a graph showing what degree of foaming ratio H is obtained for the molten metal when the in-oven atmospheric pressure Pa is reduced more than the balanced gas partial pressure Px of the N_2 gas component in the molten metal. The X axial coordinate takes the mean during the pressure reducing process, relating to

the difference (Px – Pa) between the balanced gas partial pressure Px and the in-oven atmospheric pressure Pa. As shown in Fig.3, foaming ratio H is obtained as indicated by the following formula by checking a bath surface height h_2 what degree a bath surface height h_1 increases after a foaming based on a bath surface height h_0 before the foaming:

$H = h1 - h_0/h_1 = h_2/ h_0+h_2$

As is clear in the drawing, when mean (Px – Pa) is 0.1 atm or greater, foaming ratio H becomes 0.8 or higher. Accordingly, in order to obtain metal foam after a solidification, the in-oven atmospheric pressure Pa needs to be controlled so that at least Px – Pa becomes 0.1 atm or greater.

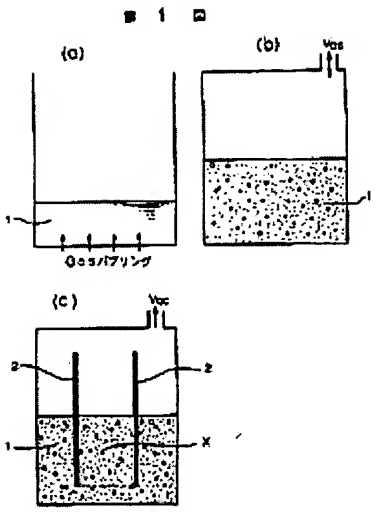
[Advantageous Effect of the Invention]

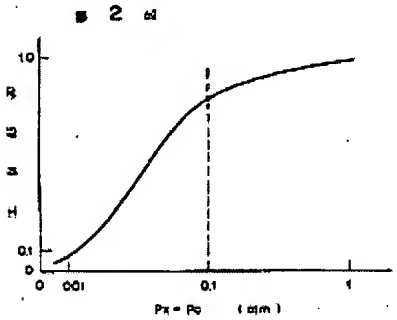
As described above, according to the invention, the uniform foaming state is achieved in the molten metal without applying the mixing operation of the foaming agent, thereby easily increasing the productivity of metal foam.

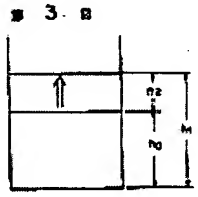
4. Brief Description of the Invention

Fig.1 (a), Fig.1 (b) and Fig.1 (c) illustrate the processes of the method of the invention. Fig.2 is a graph illustrating a correlation between foaming ratio H and mean (Px – Pa). Fg.3 illustrates an obtaining method for foaming ratio H.

In the drawings, reference number 1 refers to a molten metal, and 2 to copper plates.







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